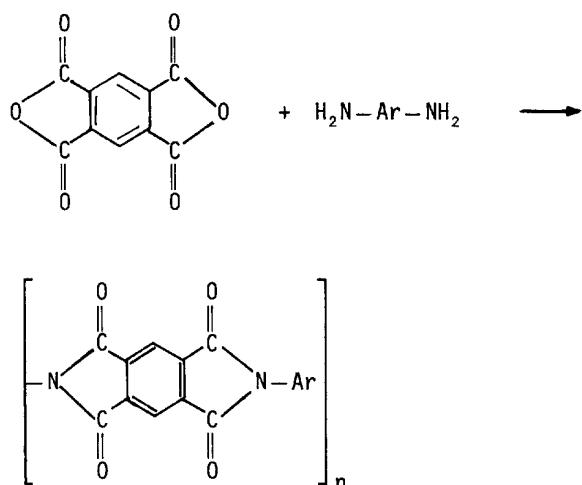


The polyimides¹⁶⁾ are prepared from aromatic dianhydrides and aromatic diamines, e.g.:

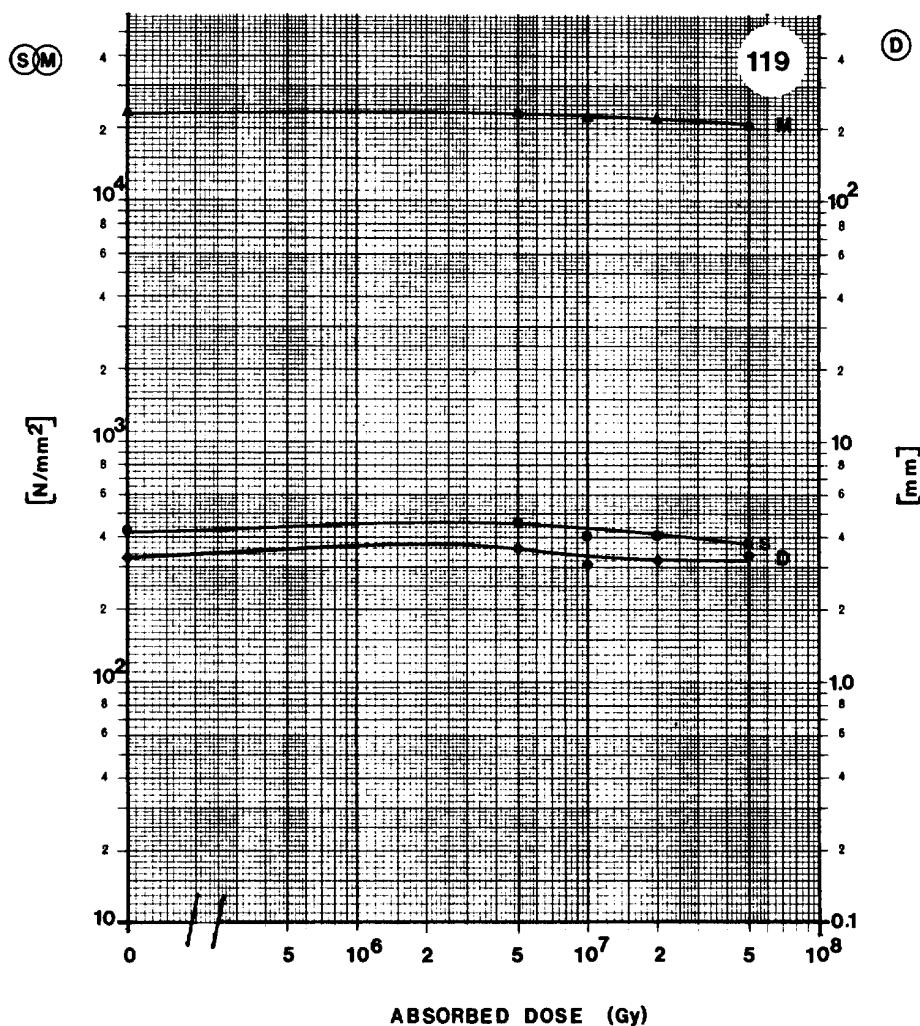


where Ar is m- or p-phenylene, biphenyl, naphthylene, etc.

POLYIMIDE

- 189 -

No.	Material and Supplier	Dose (Gy)	Ultimate flex. strength S (N/mm ²)	Deflexion at break D (mm)	Modulus of elasticity M (N/mm ²)
119	Polyimide + glass fibre ISOLA	0	426.7 ± 71.6	3.3 ± 0.6	2.31 ± 0.11 × 10 ⁴
		5 × 10 ⁶	464.0 ± 83.4	3.6 ± 0.7	2.33 ± 0.06 × 10 ⁴
		1 × 10 ⁷	406.1 ± 102.0	3.1 ± 0.8	2.23 ± 0.20 × 10 ⁴
		2 × 10 ⁷	409.1 ± 84.4	3.2 ± 0.8	2.22 ± 0.22 × 10 ⁴
		5 × 10 ⁷	379.6 ± 50.0	3.4 ± 0.8	2.09 ± 0.11 × 10 ⁴
152	KINEL 5.502 Rhône-Poulenc	0	67.7 ± 7.8	2.1 ± 0.6	5.82 ± 0.07 × 10 ³
		5 × 10 ⁶	63.7 ± 4.9	2.1 ± 0.2	5.83 ± 0.16 × 10 ³
		1 × 10 ⁷	53.0 ± 5.9	1.8 ± 0.3	5.90 ± 0.12 × 10 ³
		3 × 10 ⁷	53.0 ± 6.9	2.1 ± 0.2	5.27 ± 0.48 × 10 ³
197	KINEL 5.504 Rhône-Poulenc	0	375.7 ± 18.6	2.1 ± 0.2	2.03 ± 0.03 × 10 ⁴
		5 × 10 ⁷	263.9 ± 1.0	2.9 ± 0.2	1.73 ± 0.06 × 10 ⁴
		1 × 10 ⁸	193.3 ± 8.8	1.9 ± 0.1	1.35 ± 0.03 × 10 ⁴
198	KERIMID 601 (glass fibre 181 E) Rhône-Poulenc	0	503.3 ± 42.5	5.0 ± 0.9	3.05 ± 0.28 × 10 ⁴
		1 × 10 ⁷	537.3 ± 16.7	5.3 ± 0.1	2.97 ± 0.13 × 10 ⁴
		5 × 10 ⁷	747.1 ± 159.5	5.3 ± 0.4	3.34 ± 0.31 × 10 ⁴
		1 × 10 ⁸	143.6 ± 11.8	3.7 ± 0.2	9.22 ± 0.41 × 10 ³
314	Polyimide + glass Compound 17287 Shamban	0	108.9 ± 11.8	0.5 ± 0.1	2.06 ± 0.10 × 10 ⁴
		5 × 10 ⁵	51.0 ± 0.8	0.6 ± 0.0	8.74 ± 0.13 × 10 ³
		1 × 10 ⁶	55.9 ± 1.0	0.7 ± 0.0	8.85 ± 0.11 × 10 ³
315	Polyamide-imide Compound 17286 Shamban	0	144.9 ± 33.3	8.0 ± 4.0	4.25 ± 0.11 × 10 ³
		5 × 10 ⁵	165.8 ± 9.2	8.7 ± 1.7	4.36 ± 0.15 × 10 ³
		1 × 10 ⁶	145.2 ± 16.7	7.3 ± 2.0	4.06 ± 0.13 × 10 ³
316	Polyimide Compound 17242 Shamban	0	36.7 ± 4.2	2.8 ± 0.4	6.61 ± 0.47 × 10 ³
		5 × 10 ⁵	49.6 ± 5.9	1.4 ± 0.2	7.20 ± 0.35 × 10 ³
		1 × 10 ⁶	53.9 ± 0.4	1.4 ± 0.1	7.75 ± 0.13 × 10 ³

MATERIAL: POLYIMIDE + GLASS FIBRE**SUPPLIER:** ISOLA**Remarks:**

CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	426.7 N/mm ²
D	Deflexion at break	3.3 mm
M	Modulus of elasticity	2.3 × 10 ⁴ N/mm ²

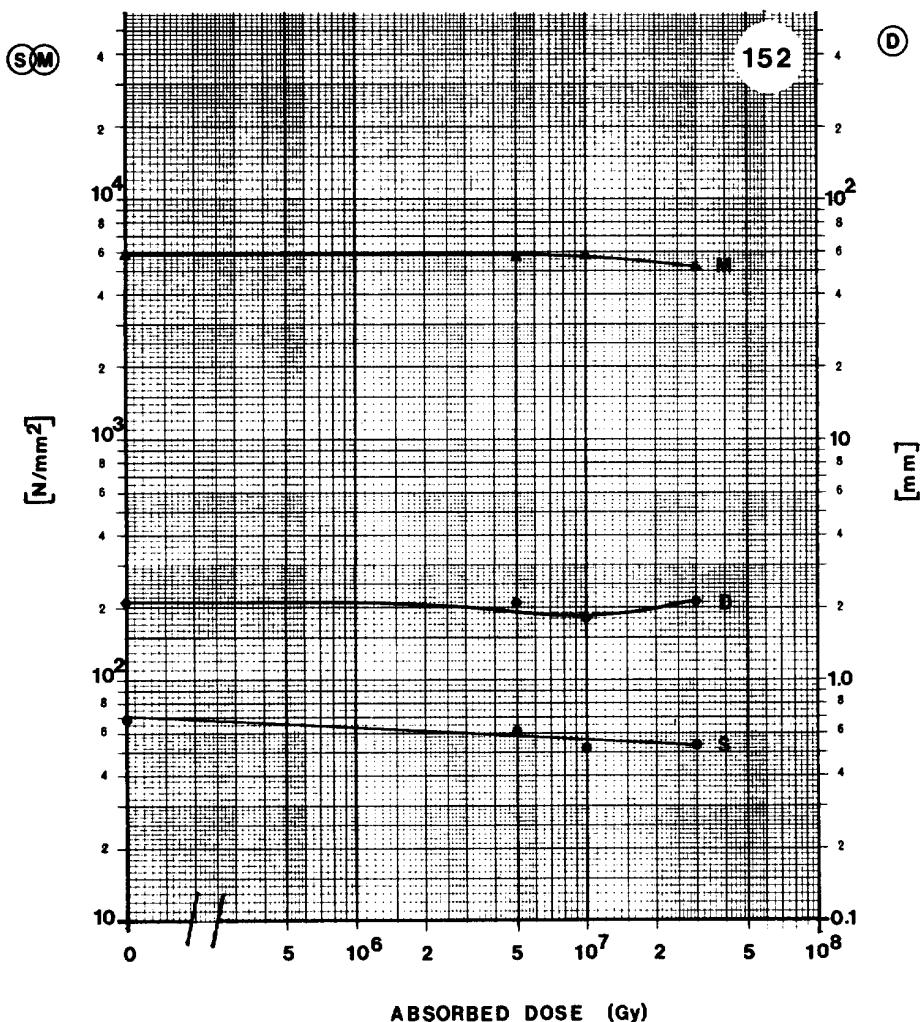
POLYIMIDE

- 192 -

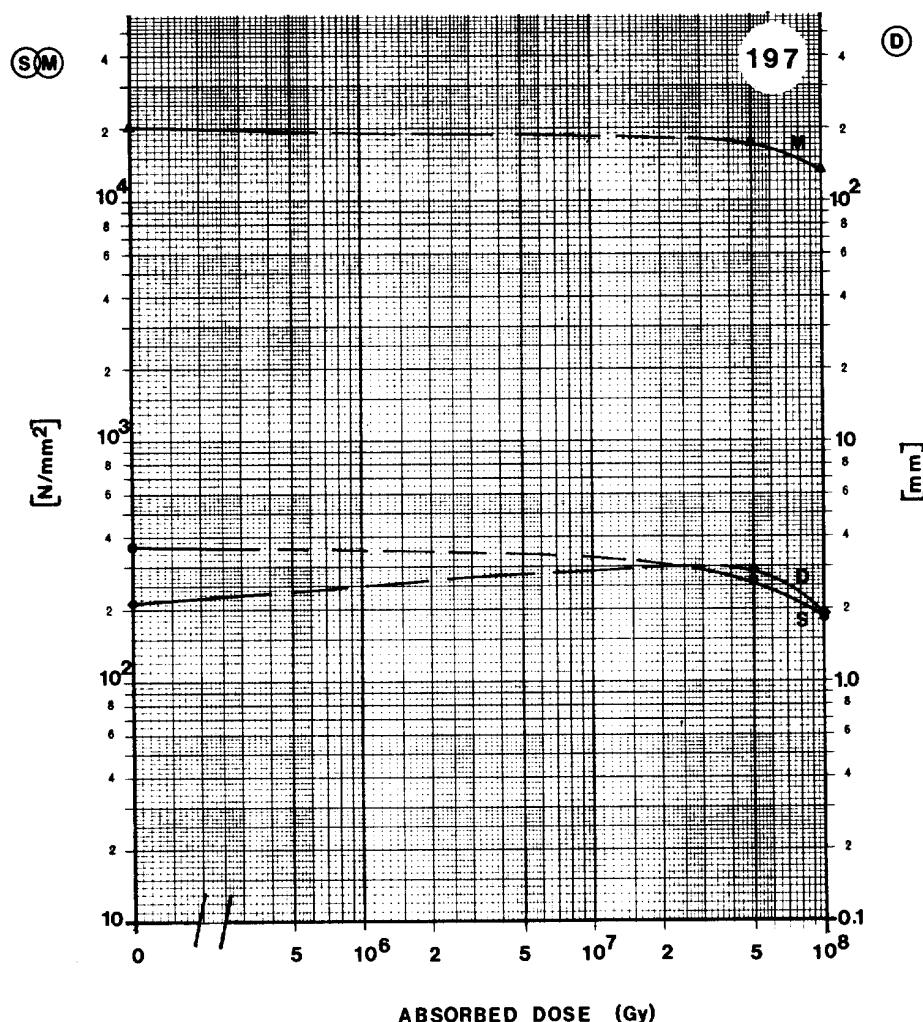
MATERIAL: KINEL 5.502

SUPPLIER: RHÔNE-POULENC

Remarks: NO LONGER COMMERCIALLY AVAILABLE



CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	67.7 N/mm ²
D	Deflexion at break	2.1 mm
M	Modulus of elasticity	5.8 × 10 ³ N/mm ²

MATERIAL: KINEL 5.504**SUPPLIER:** RHÔNE-POULENC**Remarks:**

CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	375.7 N/mm ²
D	Deflection at break	2.1 mm
M	Modulus of elasticity	2.0 × 10 ⁴ N/mm ²

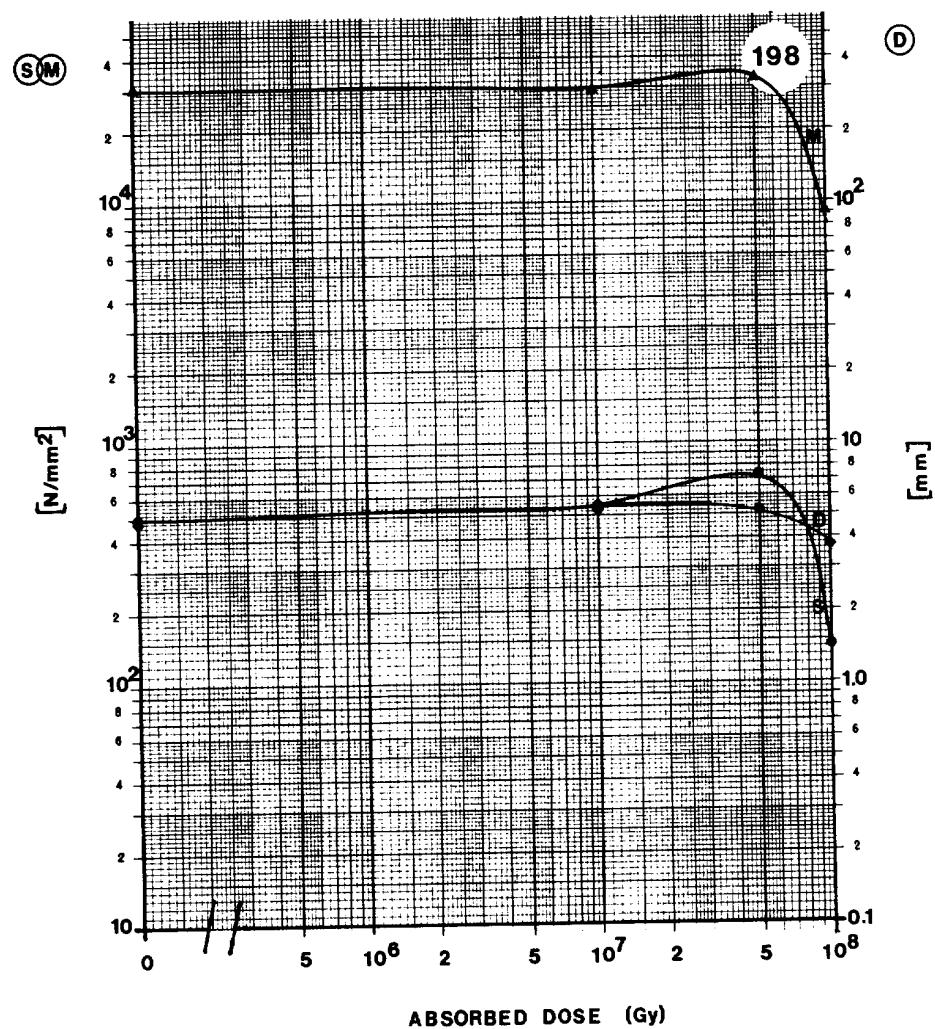
POLYIMIDE

- 194 -

MATERIAL: KERIMID 601 (GLASS FIBRE 181 E)

SUPPLIER: RHÔNE-POULENC

Remarks:

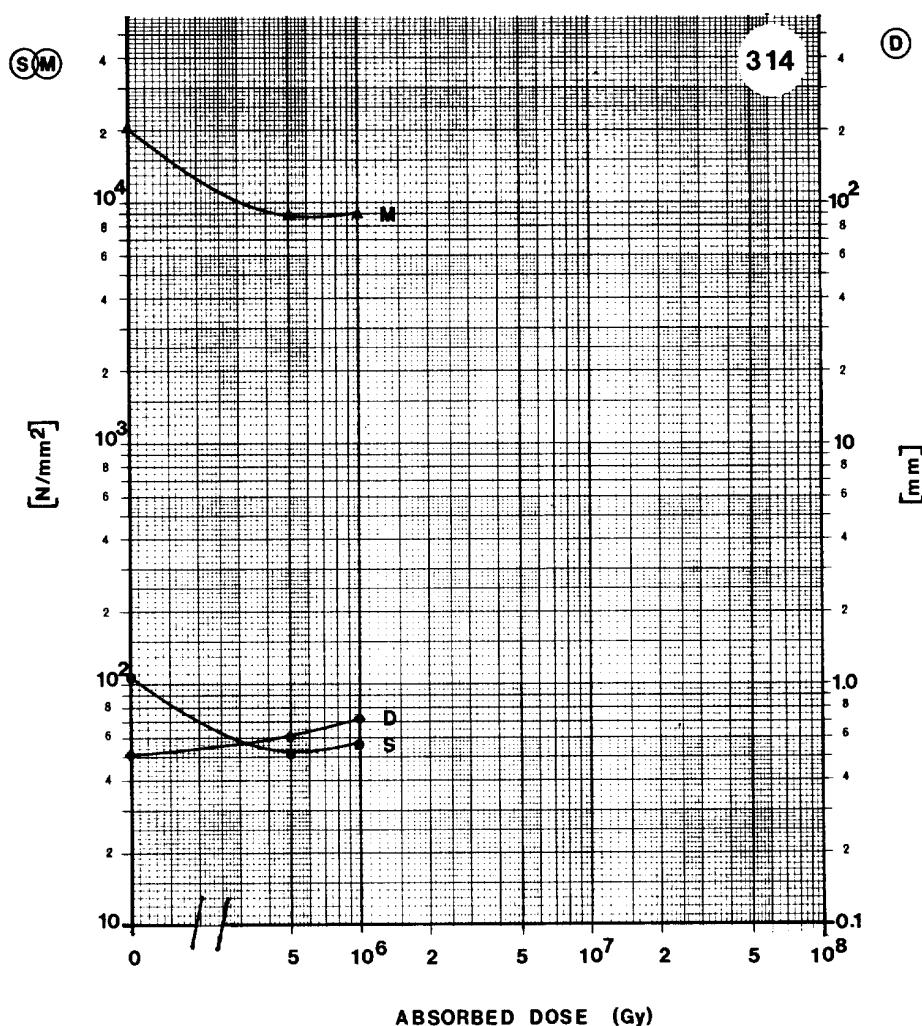


CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	503.3 N/mm ²
D	Deflection at break	5.0 mm
M	Modulus of elasticity	3.1 × 10 ⁴ N/mm ²

MATERIAL: POLYIMIDE + GLASS; COMPOUND 17287

SUPPLIER: SHAMBAK

Remarks: USABLE FOR SEALS



CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	108.9 N/mm^2
D	Deflection at break	0.5 mm
M	Modulus of elasticity	$2.1 \times 10^4 N/mm^2$

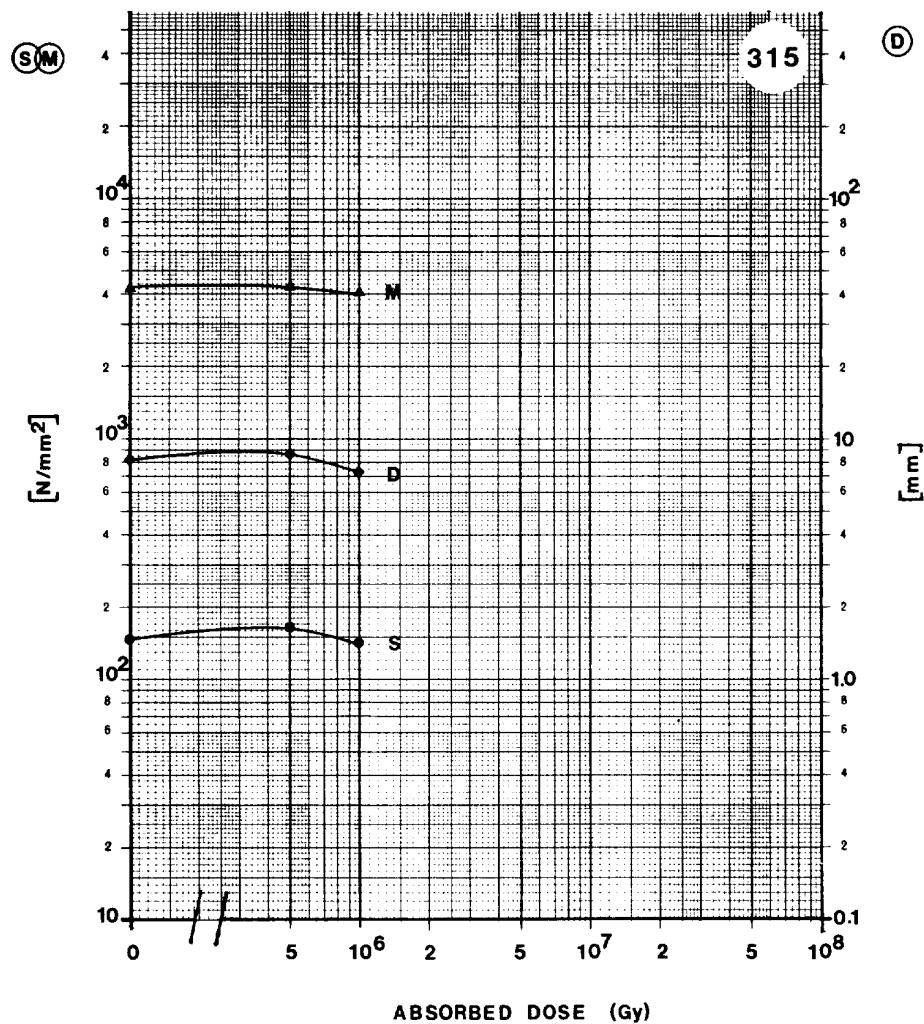
POLYIMIDE

- 196 -

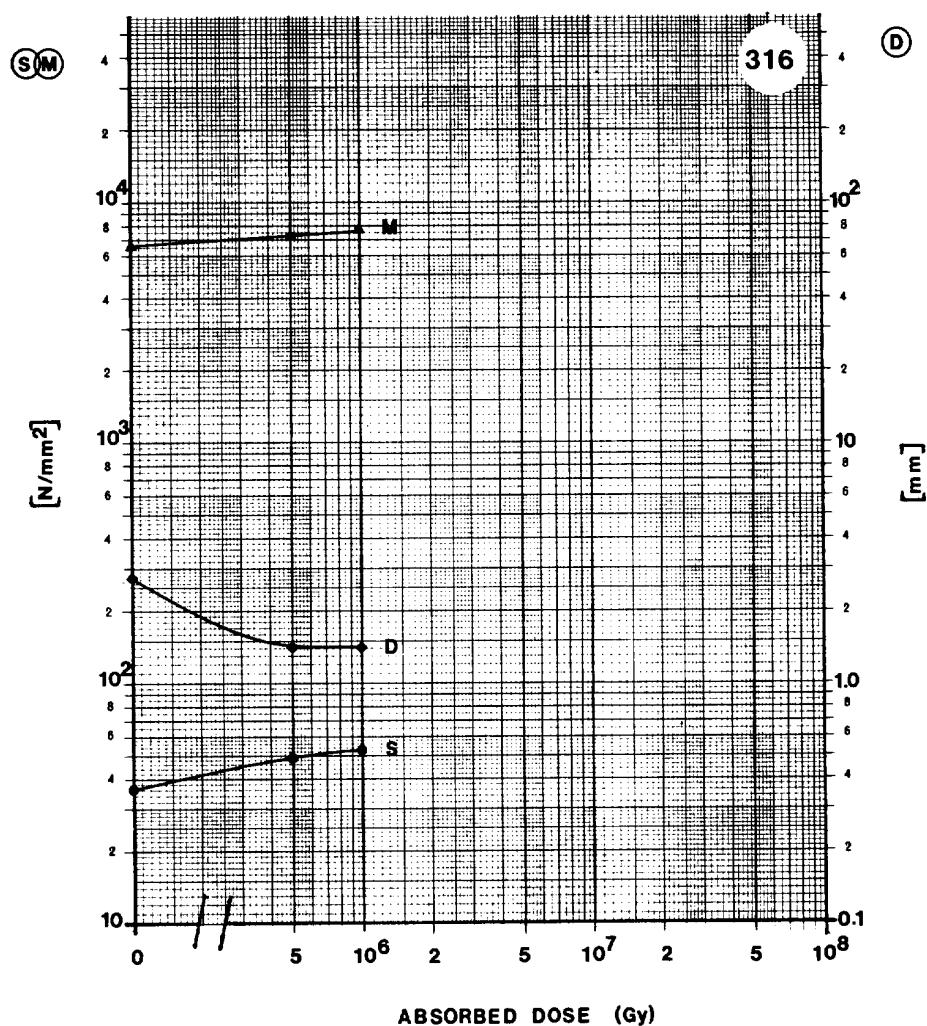
MATERIAL: POLYAMIDE-IMIDE; COMPOUND 17286

SUPPLIER: SHAMBAK

Remarks: USABLE FOR SEALS



CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	144.9 N/mm ²
D	Deflexion at break	8.0 mm
M	Modulus of elasticity	4.3 x 10 ³ N/mm ²

MATERIAL: POLYIMIDE; COMPOUND 17242**SUPPLIER:** SHAMBAK**Remarks:** USABLE FOR SEALS

CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	36.7 N/mm ²
D	Deflexion at break	2.8 mm
M	Modulus of elasticity	6.6 × 10 ³ N/mm ²

POLYURETHANE

- 199 -

Isocyanate resins⁴), commonly known as polyurethanes, are formed by the reaction of compounds containing two or more active hydrogen groups, such as hydroxyl, amino, or carboxyl groups, with diisocyanates ($O=C=N-R-N=C=O$).

The principal compounds are polyesters and polyethers. Highly branched polyesters give rigid polyurethanes.

POLYURETHANE

- 201 -

No.	Material and Supplier	Dose (Gy)	Ultimate flex. strength S (N/mm ²)	Deflexion at break D (mm)	Modulus of elasticity M (N/mm ²)
110	Polyurethane + CaCO ₃ BBC Mannheim	0	67.7 ± 1.0	4.6 ± 0.1	4.04 ± 0.09 × 10 ³
		5 × 10 ⁶	60.8 ± 2.9	4.3 ± 0.5	3.50 ± 0.05 × 10 ³
		1 × 10 ⁷	59.8 ± 5.9	3.7 ± 0.5	3.82 ± 0.19 × 10 ³
		2 × 10 ⁷	45.1 ± 6.9	3.1 ± 0.5	2.94 ± 0.18 × 10 ³
		5 × 10 ⁷	19.6 ± 1.0	2.7 ± 0.1	1.35 ± 0.05 × 10 ³
111	Polyurethane + Al ₂ O ₃ BBC Mannheim	0	65.7 ± 3.9	3.3 ± 0.2	4.17 ± 0.10 × 10 ³
		5 × 10 ⁶	53.0 ± 1.9	3.8 ± 0.2	3.01 ± 0.09 × 10 ³
		1 × 10 ⁷	49.0 ± 2.9	3.3 ± 0.2	3.11 ± 0.09 × 10 ³
		2 × 10 ⁷	43.2 ± 1.9	3.7 ± 0.2	2.33 ± 0.05 × 10 ³
		5 × 10 ⁷	22.5 ± 1.0	2.9 ± 0.1	1.37 ± 0.13 × 10 ³
112	Polyurethane + CaCO ₃ + flexibilizer BBC Mannheim	0	32.4 ± 1.0		1.62 ± 0.06 × 10 ³
		5 × 10 ⁶	56.9 ± 1.0		3.16 ± 0.09 × 10 ³
		1 × 10 ⁷	60.8 ± 5.9	3.4 ± 0.8	3.29 ± 0.00 × 10 ³
		2 × 10 ⁷	61.8 ± 1.0	3.0 ± 0.1	3.39 ± 0.05 × 10 ³
159 (a)	DOBECKAN IF 200/25(100) + IF 200(Hardener) (35) 24 h 25 °C Dr. BECK	0	too flexible	for testing	
		5 × 10 ⁶			
		1 × 10 ⁷	20.6 ± 3.9	2.1 ± 0.3	1.82 ± 0.17 × 10 ³
		3 × 10 ⁷	19.6 ± 2.9	1.3 ± 0.2	1.84 ± 0.07 × 10 ³
160 (a)	DOBECKAN IF 1642/1(100) + IF 200(Hardener) (27) 24 h 25 °C Dr. BECK	0	too flexible	for testing	
		5 × 10 ⁶			
		1 × 10 ⁷	31.4 ± 6.9	4.0 ± 0.8	1.54 ± 0.11 × 10 ³
		3 × 10 ⁷	22.6 ± 7.8	1.9 ± 1.0	1.51 ± 0.19 × 10 ³

(a) No graph.

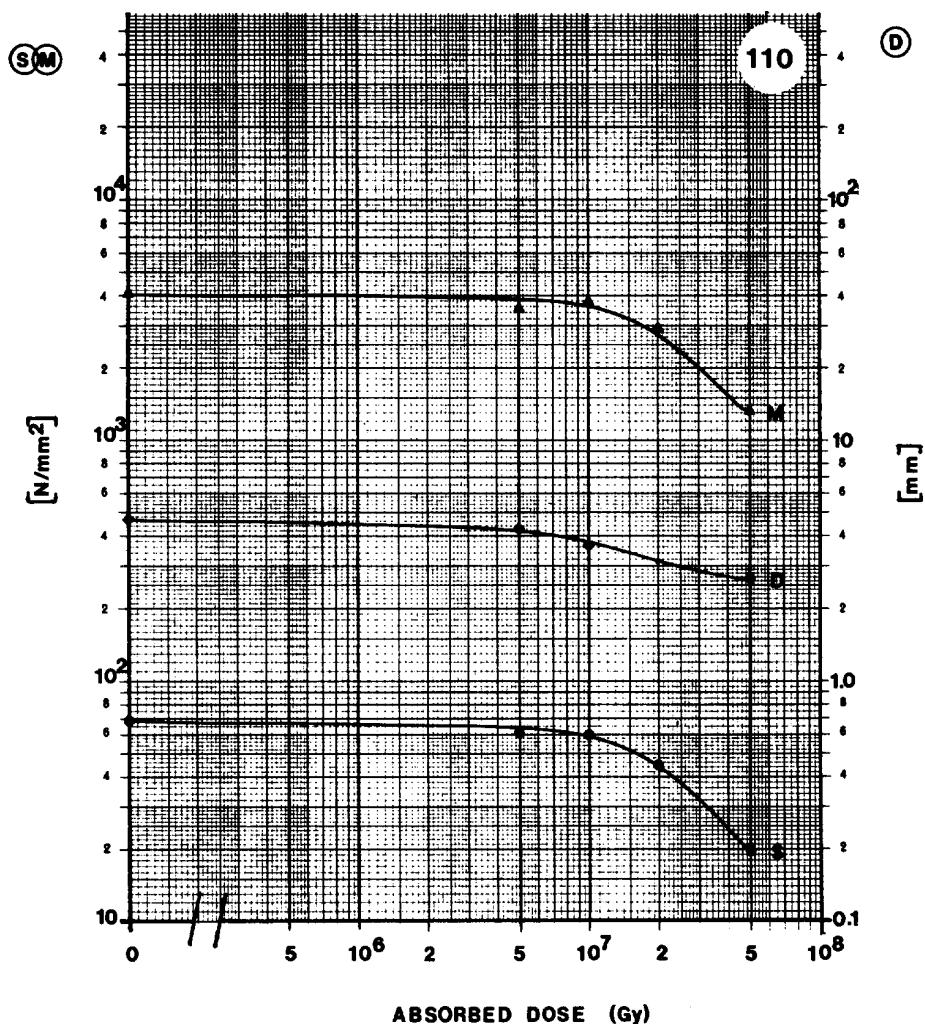
POLYURETHANE

- 203 -

MATERIAL: POLYURETHANE + CaCO_3

SUPPLIER: BBC MANNHEIM

Remarks:



CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	67.7 N/mm ²
D	Deflection at break	4.6 mm
M	Modulus of elasticity	4.0×10^3 N/mm ²

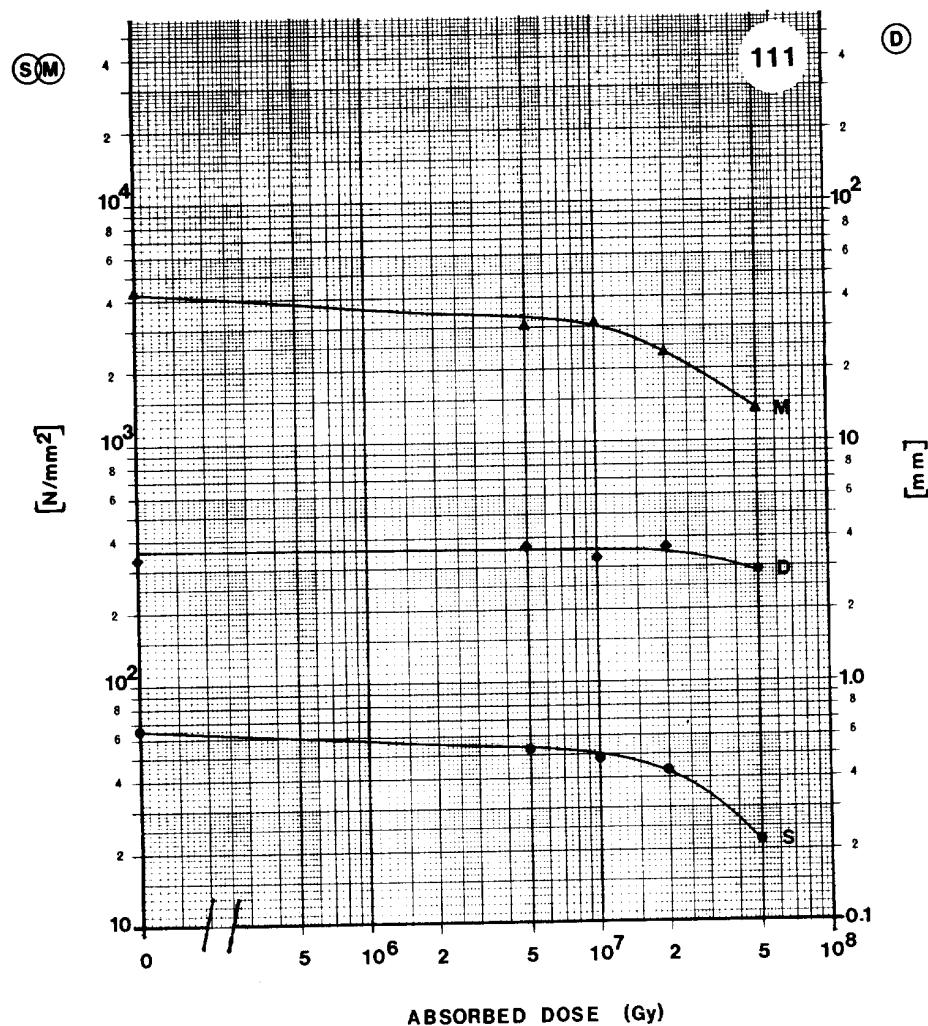
POLYURETHANE

- 204 -

MATERIAL: POLYURETHANE + Al_2O_3

SUPPLIER: BBC MANNHEIM

Remarks:



CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	65.7 N/mm^2
D	Deflexion at break	3.3 mm
M	Modulus of elasticity	$4.2 \times 10^3 \text{ N/mm}^2$

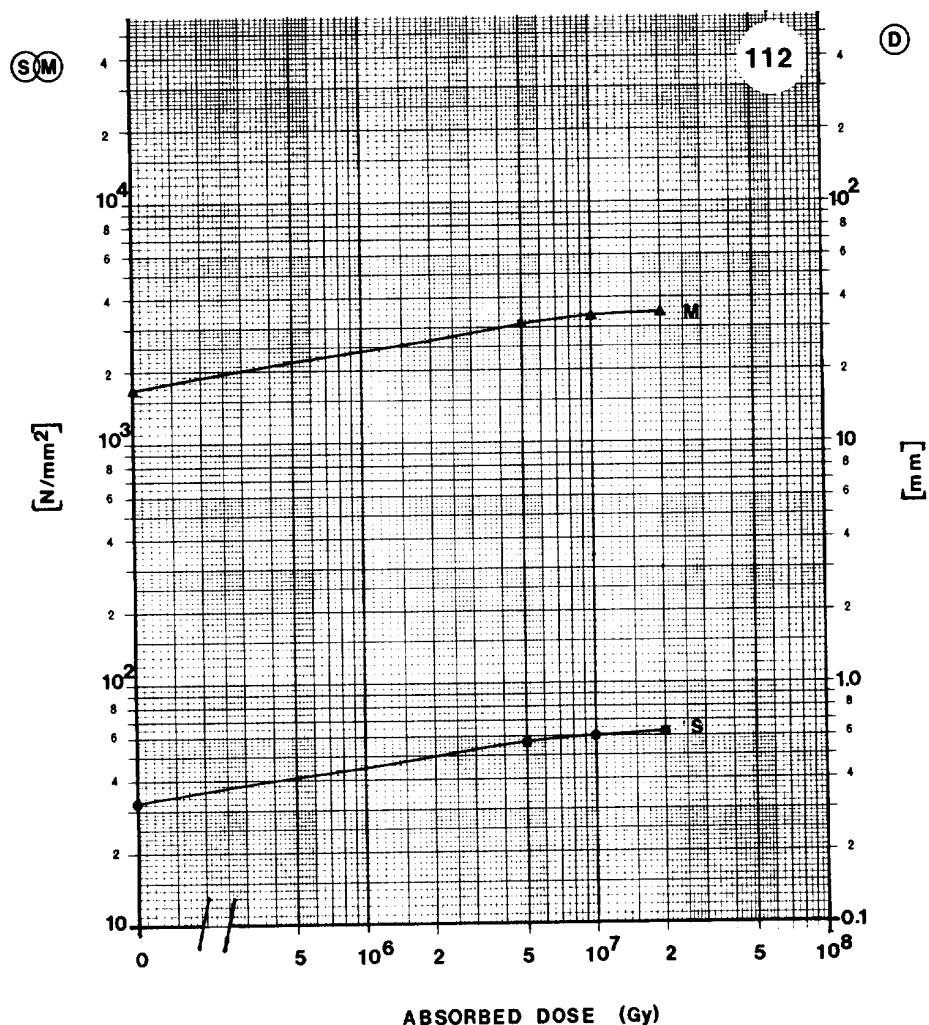
POLYURETHANE

- 205 -

MATERIAL: POLYURETHANE + CaCO_3 + FLEXIBILIZER

SUPPLIER: BBC MANNHEIM

Remarks:



CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	32.4 N/mm^2
D	Deflexion at break	- mm
M	Modulus of elasticity	$1.6 \times 10^3 \text{ N/mm}^2$

RESOFIL

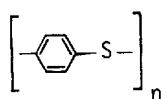
see PHENOLIC RESINS

RYTON

Polyphenylene sulfide

Ryton PPS*) is the trade name of Phillips Petroleum Company (USA) for polyphenyl sulfide.

Polyphenyl sulfide is a crystalline aromatic polymer consisting of para-substituted benzene rings connected by a single sulfur atom:



This polymer has a high thermal stability (melting point 288 °C), an outstanding chemical resistance.

*) This information is taken from a Phillips Petroleum Co. brochure.

No.	Material and Supplier	Dose (Gy)	Ultimate flex. strength S (N/mm ²)	Deflexion at break D (mm)	Modulus of elasticity M (N/mm ²)
171	RYTON PPS *)	0	205.0 ± 4.9	3.4 ± 0.1	1.31 ± 0.02 × 10 ⁴
		5 × 10 ⁶	200.1 ± 3.9	3.3 ± 0.1	1.31 ± 0.03 × 10 ⁴
		1 × 10 ⁷	199.5 ± 3.9	3.3 ± 0.1	1.29 ± 0.02 × 10 ⁴
	Phillips Petroleum **)	5 × 10 ⁶	205.0 ± 3.9	3.7 ± 0.0	1.25 ± 0.02 × 10 ⁴
		1 × 10 ⁷	207.9 ± 3.9	3.7 ± 0.0	1.27 ± 0.02 × 10 ⁴
		5 × 10 ⁷	196.2 ± 3.9	3.4 ± 0.0	1.25 ± 0.02 × 10 ⁴
310	RYTON PPS Phillips Petroleum	0	202.1 ± 3.9	2.0 ± 0.1	1.21 ± 0.02 × 10 ⁴
		5 × 10 ⁶	208.9 ± 3.9	2.1 ± 0.1	1.23 ± 0.02 × 10 ⁴
		1 × 10 ⁷	205.5 ± 6.9	2.0 ± 0.1	1.24 ± 0.02 × 10 ⁴
		5 × 10 ⁷	201.1 ± 0.0	2.0 ± 0.0	1.22 ± 0.00 × 10 ⁴

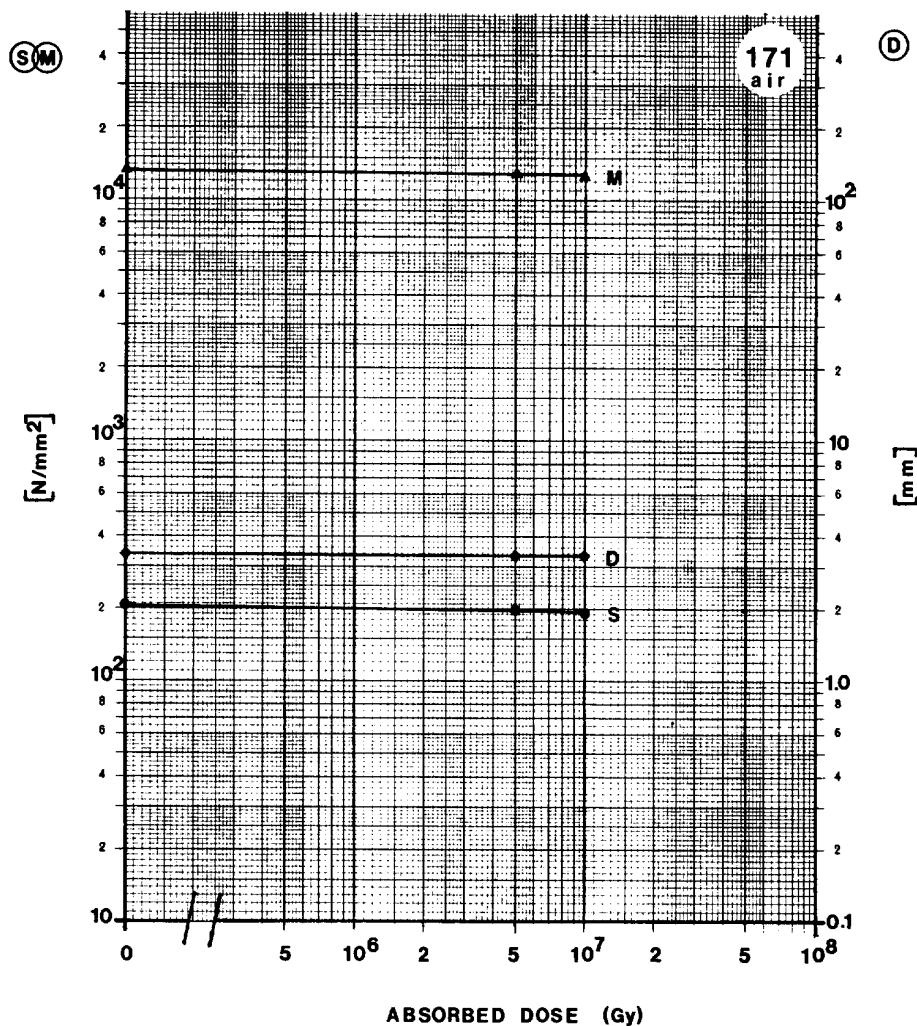
*) Irradiated in air

**) Irradiated in water

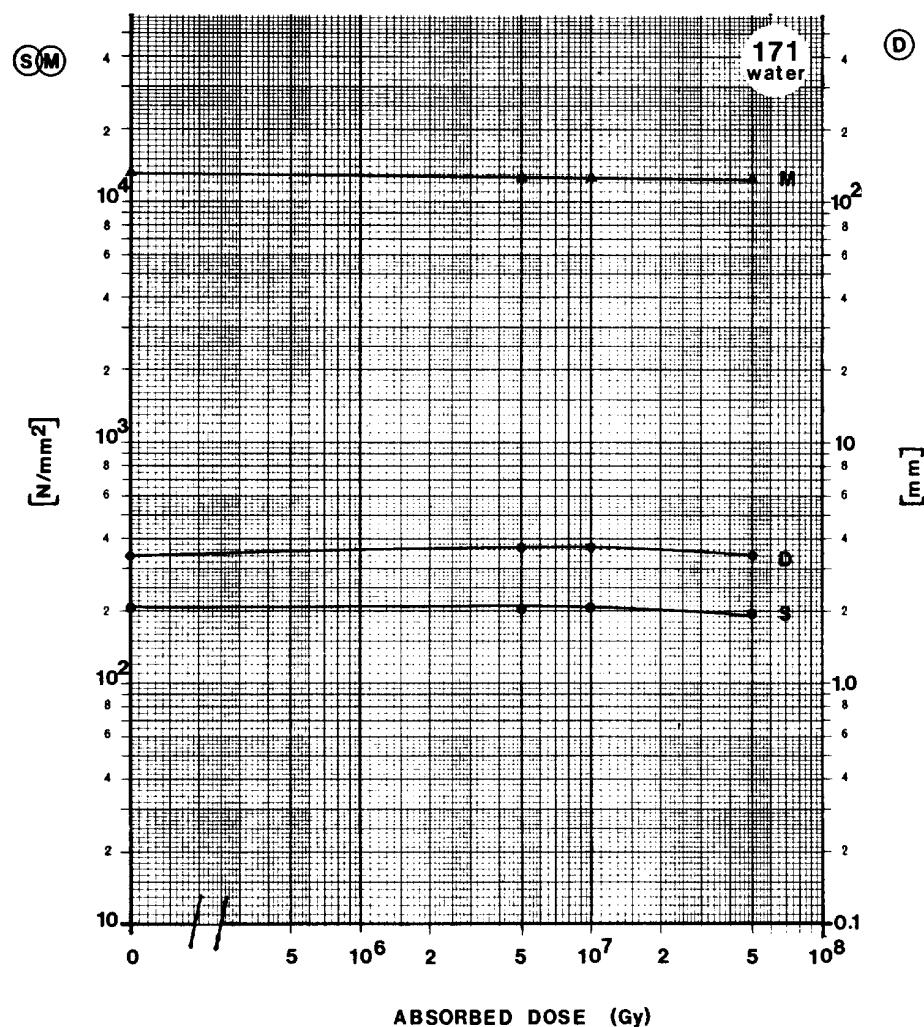
MATERIAL: RYTON PPS

SUPPLIER: PHILLIPS PETROLEUM

Remarks:



CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	205.0 N/mm^2
D	Deflexion at break	3.4 mm
M	Modulus of elasticity	$1.3 \times 10^4 \text{ N/mm}^2$

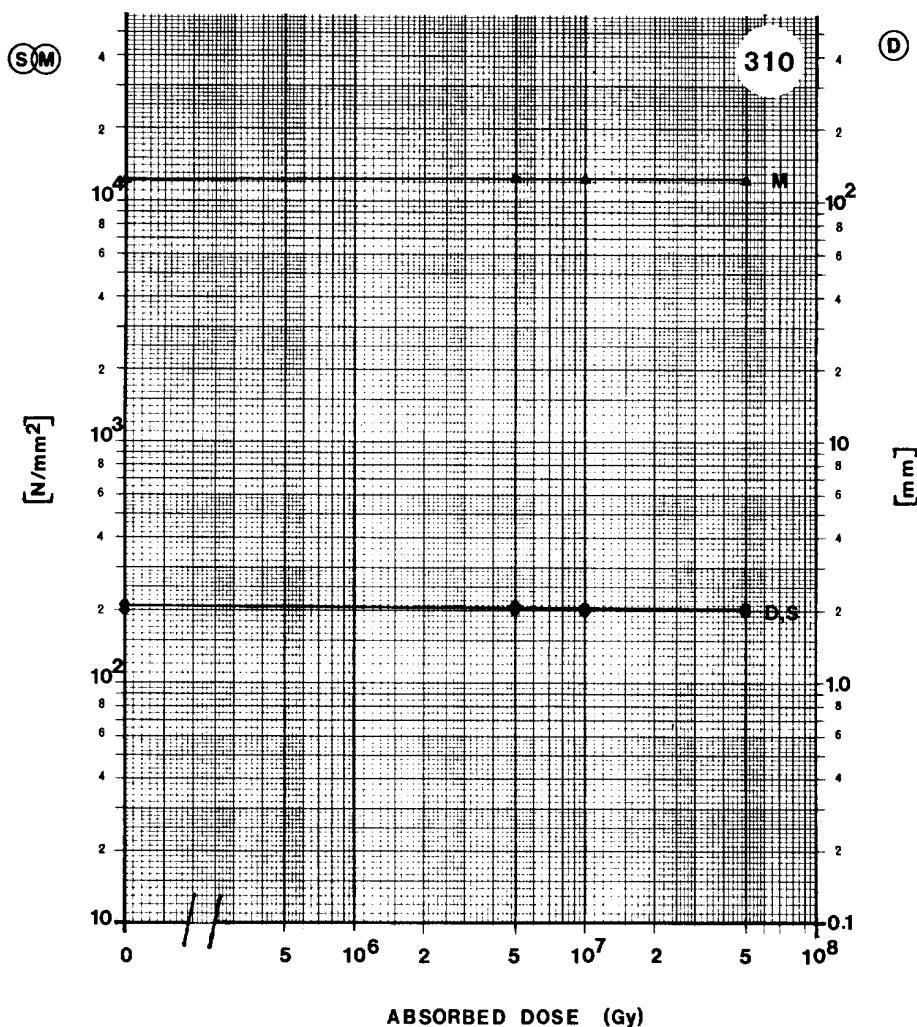
MATERIAL: RYTON PPS**SUPPLIER:** PHILLIPS PETROLEUM**Remarks:**

CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	205.0 N/mm ²
D	Deflection at break	3.4 mm
M	Modulus of elasticity	1.3 × 10 ⁴ N/mm ²

MATERIAL: RYTON PPS

SUPPLIER: PHILLIPS PETROLEUM

Remarks:



CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	202.1 N/mm ²
D	Deflexion at break	2.0 mm
M	Modulus of elasticity	1.2 x 10 ⁴ N/mm ²

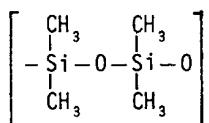
SAMICANIT, SAMICATHERM
see EPOXY RESINS

SILICONE RESINS

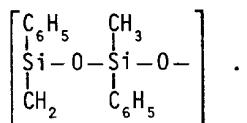
SILICONE RESINS

- 219 -

Silicone resins^{16,20}) for technical applications are in general cross-linked polymethylsiloxane:



or polymethylphenylsiloxane:

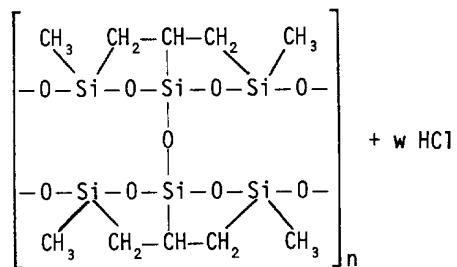
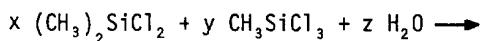


The elasticity and resistance to temperature increase with the content of the phenyl group.

The cross-linked (thermoset) polymer can be prepared using one of three different methods:

- 1) Hydrolizing dimethyldichlorosilane followed by air oxidization.
- 2) Co-condensing the product of a mixture of dimethyldichlorosilane and silicon tetrachloride.
- 3) Methylation of silicon tetrachloride followed by hydrolysis.

A typical reaction to produce a silicone resin is



SILICONE RESINS

- 221 -

No.	Material and Supplier	Dose (Gy)	Ultimate flex. strength S (N/mm ²)	Deflexion at break D (mm)	Modulus of elasticity M (N/mm ²)
120	Silicone resin + glass fibre ISOLA	0	152.0 ± 5.9	2.5 ± 0.2	1.29 ± 0.01 × 10 ⁴
		5 × 10 ⁶	198.2 ± 11.8	2.7 ± 0.2	1.50 ± 0.11 × 10 ⁴
		1 × 10 ⁷	200.1 ± 26.5	2.7 ± 0.1	1.55 ± 0.03 × 10 ⁴
		2 × 10 ⁷	194.2 ± 7.8	2.6 ± 0.2	1.59 ± 0.03 × 10 ⁴
		5 × 10 ⁷	178.5 ± 11.8	2.3 ± 0.2	1.58 ± 0.03 × 10 ⁴
195	Solventless silicone resin Veridur® reinforced with a thermally sized glass-woven tape BBC Baden	0	109.8 ± 20.6	2.3 ± 0.3	1.38 ± 0.17 × 10 ⁴
		5 × 10 ⁷	96.1 ± 0.0	2.7 ± 0.1	1.33 ± 0.22 × 10 ⁴

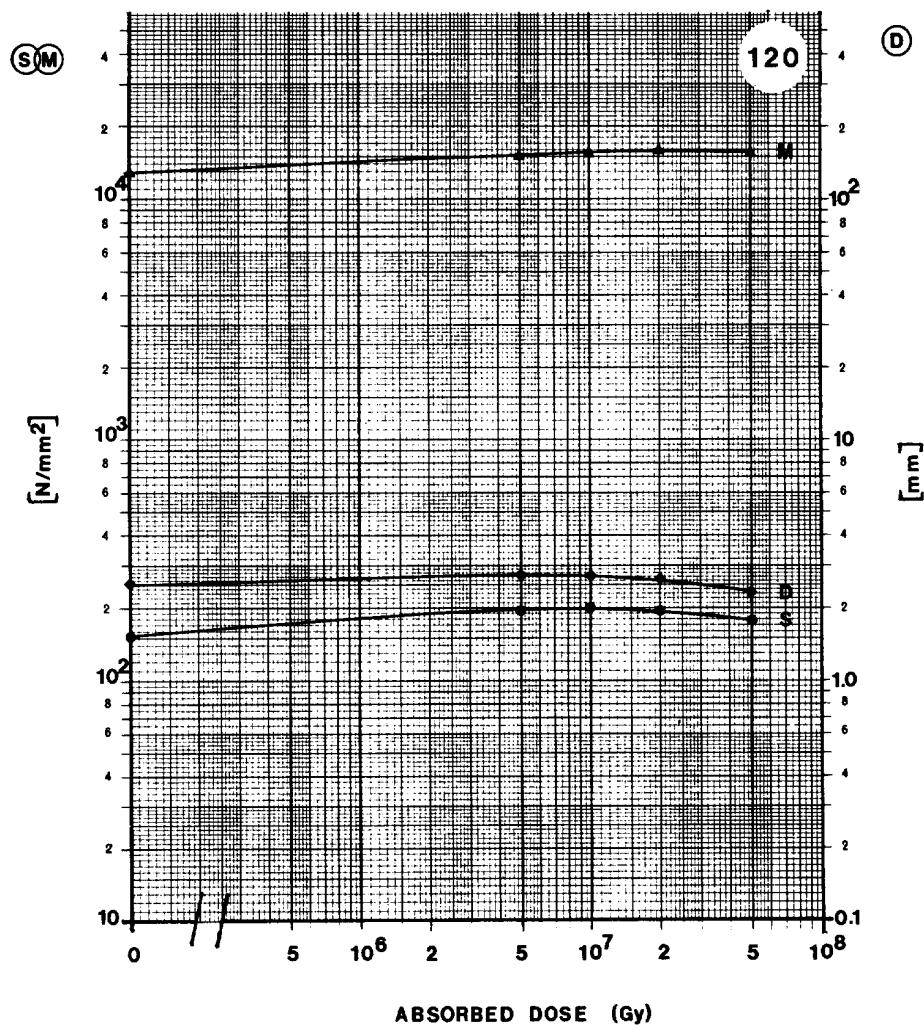
SILICONE RESINS

- 223 -

MATERIAL: SILICONE RESIN + GLASS FIBRE

SUPPLIER: ISOLA

Remarks:



CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	152.0 N/mm^2
D	Deflexion at break	2.5 mm
M	Modulus of elasticity	1.3×10^4 N/mm^2

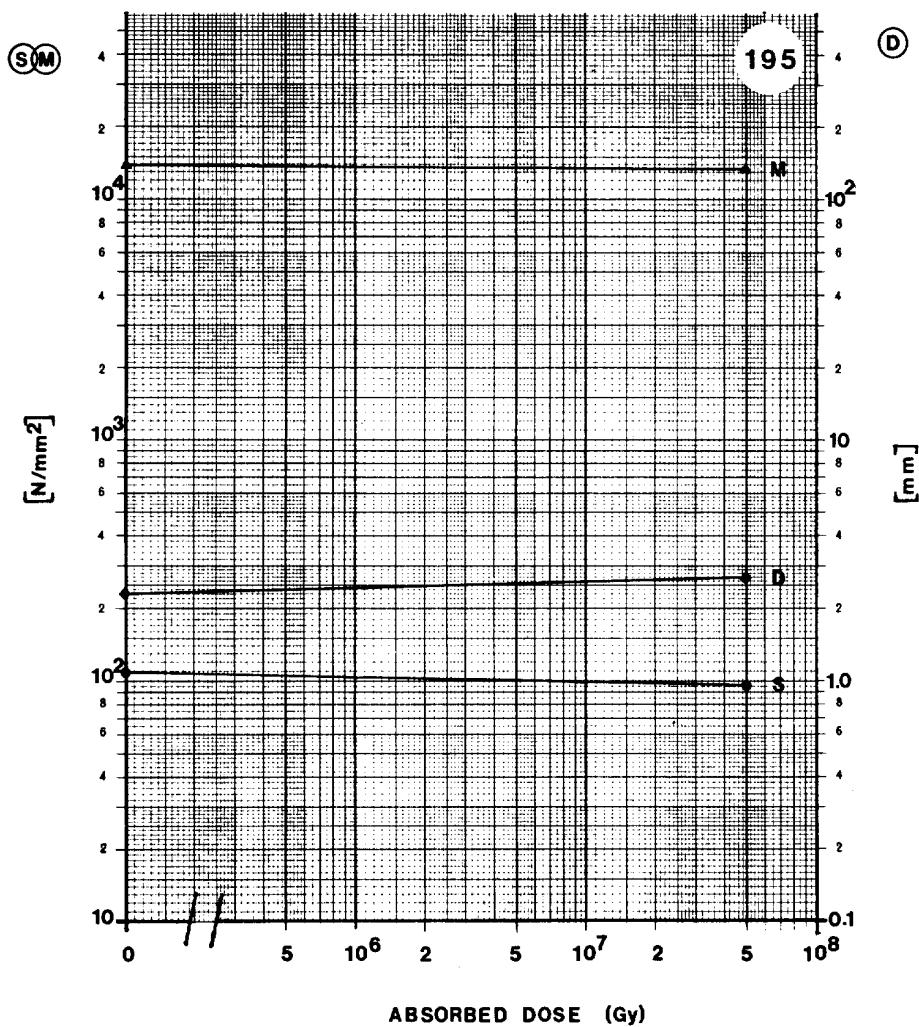
SILICONE RESINS

- 224 -

MATERIAL: SOLVENTLESS SILICONE RESIN VERIDUR® REINFORCED
WITH A THERMALLY SIZED GLASS-WOVEN TAPE

SUPPLIER: BBC BADEN

Remarks:



CURVE	PROPERTY	INITIAL VALUE
S	Ultimate flexural strength	109.8 N/mm ²
D	Deflexion at break	2.3 mm
M	Modulus of elasticity	1.4 × 10 ⁴ N/mm ²

VERIDUR

Trade name of BBC Baden
see SILICONE RESIN

VETRESIT

Trade name of MICAFIL
see NOVOLAC

VETRONIT

see EPOXY RESINS